

## Claims

[001] Method for measuring at least one state characteristic of oil or fat in a device that uses oil or fat and is provided with a filtering apparatus (1; 101) comprising a filter housing (2) and at least one filter element (7) which is inserted therein. According to said method, at least one sensor (35, 36; 135; 235) of a measuring device (30; 130; 230) is introduced into a measurement space (8; 208) located in the oil or fat circuit in order to measure at least one state characteristic of the oil or fat, and the measured values thereof are evaluated using measuring electronics (32; 132) that are connected to the at least one sensor (35, 36; 135; 235), characterized in that a microfilter, ultrafilter or nanofilter element (7) is used as a filter element.

[002] Method according to Claim 1, characterized in that the sensor (35, 36; 135, 235) is placed in the filter housing (2).

[003] Method according to Claim 1 or 2, characterized in that the sensor (35, 36; 135, 235) is placed in the filter housing (2) in such a way that it is enclosed by the filter material of the filter element (7).

[004] Method according to any one of the preceding claims, characterized in that the measurements are performed in a filtering apparatus (1) which is arranged in a bypass flow of the oil circuit.

[005] Method according to any one of the preceding claims, characterized in that a hand device is used as a measuring device (30) for temporary measurement, which preferably measures the dielectric constant of the oil or fat with the help of a capacitor.

[006] Method according to any one of the preceding claims, characterized in that for temporary measurement the oil or fat line to the filter housing (2) is interrupted, preferably with the help of a valve or shut-off cock (11).

[007] Method according to any one of the preceding claims, characterized in that the at least one sensor (35, 36; 135) is guided through an insertion opening (20) in the housing cover (3) closing the filter housing (2) into the measurement space (8).

[008] Method according to any one of the preceding claims, characterized in that measurement is performed in an oil circuit which serves the purpose of lubricating an engine which is operated with a fuel containing RME (rape methyl ester) or biodiesel.

[009] Filtering apparatus for oils or fats, in particular in the field of engines, hydraulics, transmissions, turbines or food, with a filter housing (2) with

at least one inlet (9) and one outlet (15) for the oil or fat, with an oil or fat filter element (7) used in the filter housing (2), with at least one measurement space (8) in the filter housing (2) as well as a sensor (35, 36; 135) in a measuring device (30; 130) for the measurement of at least one state characteristic of the oil or fat in the measurement space (8), characterized in that the filter element (7) is constructed as a microfilter, ultrafilter or nanofilter element.

[010] Filtering apparatus according to Claim 9, characterized in that the filter element (7) encloses the measurement space (8).

[011] Filtering apparatus according to Claim 9 or 10, characterized in that the filter material of the filter element (7) consists of cellulose and/or fiberglass and/or ceramic.

[012] Filtering apparatus according to any one of Claims 9 through 11, characterized in that the filter element (7) is able to filter out particles with a size of less than 5  $\mu\text{m}$ , preferably less than 3  $\mu\text{m}$ .

[013] Filtering apparatus according to any one of Claims 9 through 12, characterized in that the measurement space (8) is arranged in the interior of a filter element (7) constructed as a hollow cylinder.

[014] Filtering apparatus according to any one of Claims 9 through 13, characterized by a preferably manually operable shut-off cock (11) for the oil or fat upstream of the inlet (9).

[015] Filtering apparatus according to any one of Claims 9 through 14, characterized in that the filter element (7) can be replaced after removal of the housing cover (3).

[016] Filtering apparatus according to any one of Claims 9 through 15, characterized by an insertion opening (20) on the filter housing (2), through which the sensor (35, 36; 135) can be inserted temporarily or stationary in the measurement space (8).

[017] Filtering apparatus according to Claim 16, characterized in that the insertion opening (20) for the measuring device (30; 130) is arranged at the topside of the filtering apparatus and the at least one sensor (35, 36; 135) can be inserted from above into the measurement space (8).

[018] Filtering apparatus according to Claim 16 or 17, characterized in that the insertion opening (20) is constructed in the housing cover (3) closing the filter housing (2).

[019] Filtering apparatus according to any one of Claims 15 through 18, characterized in that the insertion opening (20) is in essence aligned with the measurement space (8).

[020] Filtering apparatus according to any one of Claims 15 through 19, characterized in that the insertion opening (20) can be closed by a closing element (121),

wherein the measuring device can be or is frictionally and/or positively coupled to the measuring device (130).

[021] Filtering apparatus according to any one of Claims 9 through 20, characterized by a first retaining section (27), preferably at a housing cover (3) which is constructed for direct or indirect, frictional, stationary coupling to a corresponding second retaining section on the measuring device (130), in order to position the at least one sensor (135) stationary in the measurement space (8).

[022] Filtering apparatus according to Claim 21, characterized in that the first retaining section (27) is constructed at an insertion opening (20), preferably an insertion opening in accordance with one of Claims 15 through 19.

[023] Filtering apparatus according to any one of Claims 16 through 20, characterized in that the insertion opening (20) is constructed in such a way that the measuring device (30) can be supported during a temporary measurement on the edge of the insertion opening (20), wherein a handle (31) and preferably also a display unit (37) of the measuring device (30) protrudes from the filter housing (2).

[024] Filtering apparatus according to any one of Claims 16 through 23, characterized in that the insertion opening (20) can be closed by a screw or bayonet unit (21) which is removed for the purpose of temporary measurement.

[025] Filtering apparatus according to any one of Claims 9 through 24, characterized in that the measurement space (8) is provided in the proximity of the inlet (9) or of the outlet (15).

[026] Filtering apparatus according to any one of Claims 9 through 25, characterized in that it is cup-shaped with at least one essentially central or decentralized inlet (9) and at least one decentralized or in essence central outlet (15) for the oil or fat.

[027] Filtering apparatus according to any one of Claims 9 through 26, characterized in that at least one sensor (35, 36; 135) can be conducted in the region of the inlet (9) and at least one additional sensor (235) can be conducted in the region of the outlet (15) in corresponding measurement spaces (8; 208) of the filter housing (2).

[028] Measuring device with at least one sensor (135) for the measurement of at least one state characteristic of oils or fats, wherein the sensor (135) can be arranged in a measurement space (8) of a filter housing (2) of a filtering apparatus (1; 101), preferably of a filtering apparatus (1; 101) in accordance with any one of the preceding claims, characterized in that the measuring device (130) is or can be arranged on a housing cover (3) which can be removed for the replacement of a filter element (7) of the filter housing (2) used in the filter housing (2).

[029] Measuring device according to Claim 28, characterized in that it can be coupled positively and/or frictionally via a second retaining section (28) to a first retaining section (27) at the housing cover (3).

[030] Measuring device according to Claim 29, characterized in that the second retaining section (28) is arranged at the measuring device itself (130) and can be or is coupled to a first retaining section (27) of an insertion opening (20) which is constructed in the housing cover (3).

[031] Measuring device according to Claim 29, characterized in that the second retaining section (28) is provided at a closing element (121) which is constructed for closing of an insertion opening (20) provided in the housing cover (3) and to which the measuring device (130) can be or is coupled, and the second retaining section (28) to which the first retaining section (27) provided at the insertion opening (20) of the housing cover (3) can be or is coupled.

[032] Measuring device according to any one of Claims 28 through 31, characterized in that the at least one sensor (135) can be removed together with the closing element (121) from the filtering apparatus (1) for cleaning or replacement.

[033] Measuring device according to any one of Claims 28 through 32, characterized in that the at least one sensor (35, 36; 135) for the measurement of at least one state characteristic of the oil or fat is constructed from the following group: dielectric constant, viscosity, pH value, TAN values (total acid number), TBN values (total base number) temperature, PC values (polar compounds), FFA values (free fatty acids).

[034] Measuring device according to any one of Claims 28 through 33, characterized in that the sensor (35; 135) comprises a capacitor, preferably an interdigital capacitor, for the measurement of the dielectric constant of the oil or fat.

[035] Measuring device according to any one of Claims 28 through 34, characterized in that the least one sensor (35, 36; 135) is arranged on a measuring head (34; 134) which is connected via an attachment (33; 133) to measuring electronics (32; 132) for the evaluation of the measured values.

[036] Measuring device according to any one of Claims 28 through 35, characterized in that it comprises a display unit (37; 137) which is connected to the measuring electronics (32; 132).

[037] Device with a filtering apparatus (1; 101) and/or a measuring device (30; 130; 230) according to at least one of the preceding claims.

[038] Device according to Claim 37, characterized in that it is constructed as a motor vehicle.

[039] Device according to Claim 37 or 38, characterized in that the measuring electronics (32; 132) of the measuring device (30; 130; 230) is connected to an acoustic and/or optical display unit (37; 137) for displaying information on the state of the oil or fat via means of communications, e.g. radio or a field bus system.

[040] Device according to Claim 38, characterized in that the information can be optically reproduced on a display unit (137) in the field of view of the driver, e.g. on the instrument panel or the windshield.

[041] Device according to Claim 37, characterized in that it is constructed as a deep fryer.

[042] Device according to any one of Claims 36 through 40, characterized in that the information can be optically reproduced with different colors depending on the state of the oil or fat, e.g. with green, yellow and red color signaling devices (137a).